

LA-UR-18-25171

Approved for public release; distribution is unlimited.

Title: Navy Flight Testing Environmental Data Transfer Format Standard

Author(s): Haynes, Colin Michael

Intended for: Report

Issued: 2018-06-12

Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the Los Alamos National Security, LLC for the National Nuclear Security Administration of the U.S. Department of Energy under contract DE-AC52-06NA25396. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.



Weapon Systems Engineering Division

Navy Flight Testing Environmental Data Transfer Format Standard

Number	Revision	Effective Date
W-14-SE-0059U	A	05/24/2018

	Name	Title/Org	Date
Prepared by:	Colin Haynes	R&D Engineer/Q-14	05/15/2018
Approved by:	Christopher Scully	Group Leader/Q-14	05/24/2018

Status: <input checked="" type="checkbox"/> New <input type="checkbox"/> Major Revision <input type="checkbox"/> Minor Revision <input type="checkbox"/> Reviewed, No Change	Comments:
---	------------------

This document has been deemed unclassified by:
John Schultze, R&D Engineer

REVISION LOG

Document Number	Revision	Description of Change
W-14-SE-0059U	A	Initial release

TABLE OF CONTENTS

1.0	SUMMARY	5
2.0	INTRODUCTION	5
2.1	Background	5
2.2	Objectives	5
3.0	SPECIFICATION	5
3.1	Overview	5
3.2	Details	5
4.0	REFERENCES	9

List of Acronyms

CECWG	Collaborative Environments Characterization Working Group
LANL	Los Alamos National Laboratory
PSD	Power Spectral Density
SRS	Shock Response Spectrum
TIM	Technical Interchange Meeting

1.0 SUMMARY

This document outlines key elements of a data format standard for transferring Navy environmental flight test data between members of the Collaborative Environments Characterization Working Group (CECWG). The plan applies to measured data as well as analyzed or processed data. This plan is intended to foster a more productive collaboration between CECWG members by providing a common interface format such that each agency only has to receive and transmit data in one common format. Ideally, each agency is thus only responsible for translating formats between the native format of each agency's respective database of flight measurements and this common data transfer format.

2.0 INTRODUCTION

2.1 Background

The members of the CECWG have been authorized by the Navy's SP28 to exchange data to conduct normal environments analysis in support of Navy reentry programs.¹ In order to facilitate that data transfer, CECWG members decided that a common data exchange format would be beneficial, since each agency employs a different data management system internally. Adopting a specific transfer format is intended to minimize the amount of analyst time spent simply translating data between various formats.

2.2 Objectives

The primary goal of this plan is to ensure that all Navy environmental flight test data can be efficiently and consistently transferred between the members of the CECWG.

3.0 SPECIFICATION

3.1 Overview

Notable features:

- The format is based entirely on MATLAB structures saved in MATLAB's native .mat formatted files.^{2,3}
- Each .mat file contains a 1x1 struct names 'record.'
- Structure fieldnames throughout contain only the names of relevant fields and not their values, thus providing more flexibility in what the format can store and more consistent machine-readability.
- The "Data" substructure contains all values, units, quantities, and dimensions of the data.
- The "Labels" substructure contains name-value pairs providing information about the data and selected analysis operations.
- The "Properties" substructure contains other information about the provenance of the data.

3.2 Details

The set of information described here is intended to provide a minimum set of information that should be communicated with every individual unit of data, as well as a consistent nomenclature for how the information should be described (i.e., the specific field names, permissible values, etc.).

The specifications are given in tabular form in this section. Field names are specified in the “Field” column. “Field Type” specifies whether a given field must exist, is optional, or is required for a particular class of data. “Enumeration” specifies whether the corresponding values must come from an enumerated list (given in another table) or may be any value. The “Values” column may give either the format that the values will take or example values.

Table 1 gives the specification for the subfields of the record.data field. Table 2 gives the corresponding specification for the record.labels field. Note that PSD stands for power spectral density and SRS stands for shock response spectrum. Tables 3-8 give the enumerated values for various labels.

Table 1: record.data specification

Field Type	Field	Values	
Required	abscissa	nx1 x-axis data	
Required	abscissa_units	s	Hz
Required	abscissa_quantity	Time	Frequency
Required	ordinate	nx1 y-axis data	
Required	ordinate_units	G	G ² /Hz
Required	ordinate_quantity	MMAA SRS	Acceleration

Table 2: record.labels specification

Field Type	Field	Enumeration	Values	
Required	channelDirection	enumerated	X	Y
Required	channelID	unrestricted	V1	V2
Required	environmentName	enumerated		
Required	locationName	enumerated		
Required	locationAzimuth	unrestricted	0 deg	270 deg
Required	missileID	unrestricted	W2	
Required	sensorModel	unrestricted	Endevco 7250AM1-10	Columbia Research SA2988
Required	sensorType	unrestricted	accelerometer	strain gauge
Required	systemID	enumerated		
Required	testBodyID	unrestricted	D801	L567
Required	testBodyType	enumerated		
Required	testID	unrestricted	DASO-26	FCET-53
Required	testPhase	enumerated		
Required	validityName	unrestricted	verified	questionable

Field Type	Field	Enumeration	Values	
Required	validityExplanation	unrestricted		
Required	recordState	unrestricted	preprocessed	HP filtered
Optional	segmentDescription	unrestricted		
Optional	segmentNumber	unrestricted	1	2
Optional	eventNumber	unrestricted	1	2
Optional	DAQRange	unrestricted		
Optional	nBits	unrestricted		
PSD	PSDNumBlocks	unrestricted		
PSD	PSDOverlap	unrestricted	0.5	
PSD	PSDWindowType	unrestricted	hamming	hann
PSD	spectrumType	unrestricted	maximax autospectrum	autospectrum
SRS	SRSDamping	unrestricted	0.03	0.05
SRS	SRSModelOutput	unrestricted	absolute acceleration	
SRS	SRSSpectrumType	unrestricted	maximax	
SRS	spectrumType	unrestricted	shock response spectrum	

Note that the specification for sinusoidal environments is the same as that given for either random or shock environments, depending on the estimation technique used.

Table 3: Permissible values of the testPhase label

Prelaunch
Launch
Reentry

Table 4: Permissible values of the testBodyType label

DJTA8
JTA8
JTA2R
JTA1
JTA3

Table 5: Permissible values of the systemID label

W76-0
W76-1
W88-0
Mk5
Mk4
Mk4A

Table 6: Permissible values of the channelDirection label

channelDirection	definition
N	noise/none
R	radial
A	axial
T	tangential
X	global X
Y	global Y
Z	global Z
X*	local X
Y*	local Y
Z*	local Z

Table 7: Permissible values of the locationName label

AF&F
Aft Flange
Forward Mounting Ring
JTS
Seal Cover Flange
SRIMU
Telemetry
Forward Mount Leg

Table 8: Permissible values of the environmentName label

Flight
Transportation
Shock
Vibration
In Tube Travel Closure Rupture
First Ignition
First Separation Second Ignition
Second Separation Third Ignition
Third Separation
Post Boost
Nose Fairing Separation
RB Separation
Transient Mass Loss
Equipment Section
Exit Aerodynamics
Transition Reentry
Terminal Reentry
Reentry Precipitation
Reentry Clear Air
First Stage Operation
Second Stage Operation
Third Stage Operation

The environmentName label may be populated with more than one value from the list in Table 8. It should contain either Flight or Transportation, either Shock or Vibration, and another environment name from the list.

4.0 REFERENCES

1. Unclassified memo from Hal Skoog, “Data Sharing Among Members of the Collaborative Environments Characterization Working Group.”
2. <https://www.mathworks.com/help/matlab/structures.html>
3. https://www.mathworks.com/help/matlab/import_export/mat-file-versions.html